What is claimed is:

1. A microlithographic reduction projection catadioptric objective (100, 200) comprising in sequence from an object side to an image side of:

a catadioptric group (G1) for providing a virtual image, wherein the catadioptric group (G1) comprises a reflective field group and includes a folded off-axis field geometry; and

a dioptric group (G2) for receiving the virtual image and providing a real image.

2. A microlithographic reduction projection catadioptric objective (100. 200) comprising:

a catadioptric group (G1) including a reflective field group for providing a virtual image, wherein the reflective field group is arranged in a folded off-axis field geometry to fold light such that object and image planes are parallel to one another and perpendicular to an optical axis to enable unlimited scanning in a step/scan lithographic configuration; and

a dioptric group (G2) for receiving the virtual image and providing a real image.

3. An objective (100, 200) as in any preceding claim, wherein the catadioptric group (G1) includes at least three lens elements (E1-E3).

4. An objective (100, 200) as in any preceding claim, wherein the catadioptric group (G1) includes three mirrors (M1-M3) and two flat folding mirrors (F1, F2).

5. An objective (100, 200) according to claim 4, wherein two mirrors (M2, M3) are positioned downstream of the two flat folding mirrors (F1, F2).

6. An objective (100, 200) according to claim 5, wherein the two mirrors (M2, M3) downstream of the two flat folding mirrors (F1, F2) comprise a concave mirror and a convex mirror, respectively.

7. An objective (100, 200) according to claim 6, wherein the convex mirror (M3) is the most image forward mirror.

8. An objective (100, 200) according to claim 4, wherein one of the folding mirrors (F2) is upstream of the most image forward lens element (E2) of the catadiotric group (G1).

9. An objective (100, 200) according to claim 4, wherein the most image forward folding mirror (F2) is disposed between a second lens element (E2) and a second mirror (M2), the most image forward folding mirror (F2) deviating a beam and directing it in a direction that is parallel to a beam emanating from the object plane.

10. An objective as in any preceding claim, wherein the real image is formed with a numerical aperture of at least substantially 0.80.

11. An objective as in any preceding claim, wherein the real image is formed with a numerical aperture of at least substantially 0.85.

12. An objective according to claim 2, wherein the catadioptric group (G1) includes a most image forward convex mirror (M3) that receives a

beam after it has been twice folded and wherein the dioptric group (G2) receives a beam from the convex most image forward convex mirror (M3).

13. An objective (100, 200) according to claim 4, wherein one folding mirror (F2) and two of the mirrors (M2, M3) are upstream of the most image forward lens element (E2) of the catadioptric group (G1).

14. An objective (100, 200) according to claim 13, wherein the two mirrors (M2, M3) are more image forward than the both folding mirrors (F1, F2), where one of the two mirrors (M2) receives the folded beam from a second folding mirror (F2) and reflects the beam to the other of the two mirrors (M3) which represents the most image forward mirror of the catadioptric group (G1).

15. An objective (100, 200) according to claim 2, wherein the catadioptric group (G1) includes a single-pass lens element (E1) and first and second folding mirrors (F1, F2) that are arranged so that a beam incident to the single-pass lens element (E1) and exiting the dioptric group (G2) propagate along substantially parallel axes.

16. An objective (100, 200) as in any preceding claim, wherein a least image forward lens element (E4) of the dioptric group (G2) is a negative lens and a most image forward lens element (E16) of the dioptric group (G2) is a positive lens.

17. An objective (100, 200) according to claim 4, wherein second and third mirrors (M2, M3) are arranged upstream of the two folding mirrors (F1, F2) and each of the three lens elements (E1-E3), the second mirror (M2) being a concave mirror that receives the folded beam from a most image

forward folding mirror (F2) and reflects the beam to the third convex mirror (M3) which reflects light to the dioptric group (G2).

18. An objective (100, 200) according to claim 2, wherein the catadioptric group (G1) includes two folding mirrors (F1, F2) and a reflective group (M2, M3) upstream of a most image forward folding mirror (F2), the reflective group (M2., M3) including one concave mirror and one convex mirror.

19. An objective (100, 200) according to claim 18, further including a negative lens group (E2, E3) disposed between the two folding mirrors (F1, F2).

20. An objective (100, 200) according to claim 2, wherein the dioptric group (G2) includes more positive lens elements than negative lens elements.

21. An objective (100, 200) according to any of claims 1 or 2, wherein the dioptric group (G2) includes a number of lens elements (E4-E16) and has a negative overall magnifying power for providing image reduction.

22. A photolithographic reduction projection catadioptric objective (100, 200), comprising:

a first optical group (G1) includes an odd number of mirrors (M1-M3); and

a second substantially refractive optical group (G2) more image forward than the first optical group (G1), the second optical group (G2) including a number of lens elements (E4-E16) and having a negative overall magnifying power for providing image reduction;

wherein the first optical group (G1) has a folded geometry for producing a virtual image and the second optical group (G2) receives and reduces the virtual image to form an image with a numerical aperture of at least substantially 0.80, wherein a beam exiting the second optical group (G2) is parallel to and displaced from a beam incident to a first lens element (E1) of the first optical group (G1).

23. An objective (100, 200) according to claim 22, wherein the first optical group (G1) comprises a catadioptric group having a single pass lens (E1) and a double-pass lens group (E2, E3).

24. An objective (100, 200) as in any of claims 22-23, wherein the first optical group (G1) includes at least three mirrors (M1-M3) arranged such that a second mirror (M2) having a concave surface faces a convex surface of a third mirror (M3) such that the second mirror (M2) receives a beam that has been folded within the first optical group (G1) and reflects the beam to the convex surface of the third mirror (M3).

25. An objective (100, 200) according to claim 24, wherein light is folded within the first optical group (G1) by first and second folding mirrors (F1, F2) that are arranged so that a beam exiting the first optical group (G1) and a beam incident to a first lens element (E1) of the first optical group (G1) propagate along substantially parallel axes.

26. An objective (100, 200) according to any of claims 22-25, wherein the second dioptric group (G2) includes more positive lens elements than negative lens elements.

27. An objective (100, 200) according to any of claims 22-25, wherein the first and second optical groups (G1, G2) include at least eight aspheric surfaces.

28. An objective (100, 200) according to any of claims 22-27, wherein the first optical group (G1) includes at least three mirrors (M1-M3) and two folding mirrors (F1, F2) with two of the three mirrors (M2, M3)being located along the optical path more image forward than the two folding mirrors (F1, F2) such that one of the two mirrors (M2) receives a folded beam from the folding mirror (F2) that is more image forward and reflects the beam to the other of the two mirrors (M3) which represents the most image forward mirror of the catadioptric group (G1).

29. An objective (100, 200) according to any of claims 22-28, wherein the first optical group (G1) includes a single pass lens (E1) and a double-pass lens group (E2, E3), the double-pass lens group (E2, E3) being disposed between first and second folding mirrors (F1, F2).

30. A photolithographic reduction projection catadioptric objective (100, 200), comprising:

a first optical group (G1) includes an odd number of mirrors (M1-M3); and

a second substantially refractive optical group (G2) more image forward than the first optical group (G1), the second optical group (G2) including a number of lenses (E4-E16) and having a negative overall magnifying power for providing image reduction;

wherein the first optical group (G1) has a folded off-axis field

geometry and provides compensative aberrative correction for the second optical group (G2) which forms an image with a numerical aperture of at least substantially 0.80.

31. A photolithographic reduction projection catadioptric objective (100, 200) devoid of a beam splitter device, the objective comprising:

a first optical group (G1) including an odd number of at least three mirrors (M1-M3) including a convex most image forward mirror (M3); and

a second substantially refractive optical group (G2) more image forward than the first optical group (G1) for receiving a beam from the convex most image forward mirror (M3) of the first group (G1) after the beam has been folded along an optical path of the first optical group (G1), wherein the second optical group (G2) includes a number of lens elements (E4-E16) for providing image reduction.

32. An objective (100, 200) according to claim 31, wherein the first optical group (G1) comprises a catadioptric group having at a positive lens (E1) and a negative lens group (E2, E3) arranged such that the beam incident to a first lens element (E1) is folded twice prior to the beam being received by a reflective image forward mirror group (M2, M3) including the convex most image forward mirror (M3).

33. An objective (100, 200) according to any of claims 31-32, wherein the second optical group (G2) forms an image with a numerical aperture of at least substantially 0.80.

34. An objective (100, 200) according to any of claims 31-32, wherein the objective has a blank mass of less than 57 kg at a 22 mm x 6 mm field operating at a numerical aperture of at least substantially 0.85.

35. An objective (100, 200) according to any of claims 31-32, wherein the second optical group (G2) forms an image with a numerical aperture of at least substantially 0.85.

36. A projection exposure apparatus comprising a light source selected from the group of light sources consisting of a DUV and a VUV light source, an illumination system, a reticle handling, positioning and scanning system, a projection objective according to any of claims 2, 22, 30 or 31 and a wafer handling, positioning and scanning system.

37. A microlithographic reduction projection objective (100, 200), comprising:

a first partial objective with a concave mirror (M1) and at least one negative lens (NL) doubly passed by light traveling to and from the concave mirror (M1);

an intermediate image (Imi); and

a second partial objective with two curved mirrors (M2, M3) and a plurality of lenses (G2).

38. An objective (100, 200) according to claim 37, wherein the second partial objective has two curved mirrors (M2, M3) forming a virtual image and imageward subsequent a lens group (G2) with reduction magnification.

39. An objective (100, 200) according to any of claims 37 or 38, wherein a system aperture (AP) is located within the second partial objective and only a purely refractive lens group is arranged between the system aperture (AP) and an image plane (IMG).

40. An objective (100, 200) according to any of claims 37-39, wherein the first partial objective is a catadioptric group providing the intermediate image (Imi) and the second partial objective comprises an optical group selected from the group of optical groups consisting of a catoptric group and a catadioptric group, for providing the virtual image and the plurality of lenses (G2) comprises a dioptric group providing the real image.

41. An objective (100, 200) according to any of claims 39-40, wherein the plurality of lenses (G2) includes a positive lens group of more than 5 lenses (E11-E16) and a least image forward lens of the purely refractive group comprises a negative lens (E10).